Instrument Incubator

Development and Demonstration of an Airborne Differential Absorption Radar for Humidity Sounding Inside Clouds

Completed Technology Project (2017 - 2019)

Project Introduction

We will develop an airborne differential absorption radar, dubbed VIPR (Vapor/Ice Profiling Radar), to demonstrate a new measurement capability of simultaneously measuring water vapor and ice content inside clouds with high precision and spatial resolution. The measurements fill a gap in the existing observing system, which struggles to profile water vapor within clouds. VIPR's observations address key unsolved science questions regarding the processes regulating cloud lifecycle and the transport of water vapor by convection. The new observations will cut across several of the Earth Science focus areas including Weather, Climate Variability and Change, and Water and Energy Cycle. The concept has an entry level TRL of 3, which we will raise to TRL 6 over a three-year effort. First, we will design and build a frequency-tunable 183 GHz radar instrument. VIPR will utilize an all-solid-state transceiver based on state-of-the-art semiconductor amplifier and frequency-multiplier/mixer technology to achieve a transmit power approaching 1 W and a receiver noise figure better than 8 dB. A frequency-modulated continuous-wave (FMCW) radar mode will be used with high isolation quasi-optical duplexing to optimize detection sensitivity. The operating frequency will be tunable over 10 GHz to span a large dynamic range of water vapor attenuation near the 183 GHz atmospheric absorption line, and a 25-cm scale monostatic reflector antenna will provide sufficient gain for airborne measurements above upper tropospheric ice clouds. Second, we will demonstrate of the measurement technique from an airborne platform. We will install VIPR in an unpressurized aircraft and acquire water vapor and cloud observations in the world's first demonstration of a cloud-profiling differential absorption radar. Retrievals that convert the differential scatterometry into water vapor profiles will be adapted from our existing algorithms based on CloudSat and the Microwave Limb Sounder. Measurement validation will be performed against in-situ water vapor measurements from coincident radiosondes.

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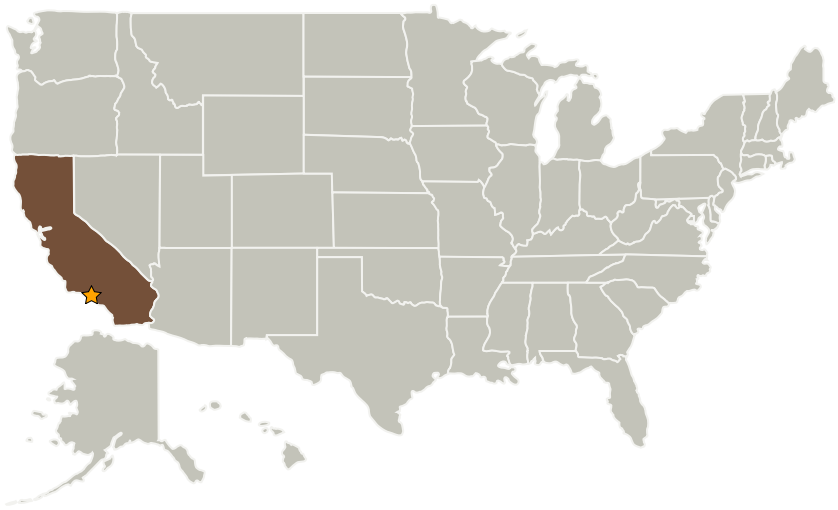
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
California

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Instrument Incubator

Project Management

Program Director:

Pamela S Millar

Program Manager:

Parminder S Ghuman

Principal Investigator:

Matthew D Lebsock

Co-Investigators:

Simone Tanelli
Karen R Piggee
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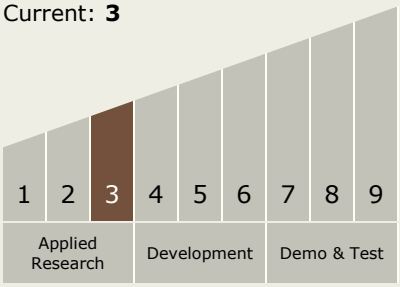
Technology Maturity (TRL)

Start: **3**
Current: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.3 In-Situ Instruments and Sensors
    - TX08.3.4 Environment Sensors

Target Destination

Earth